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GROUNDWATER MONITORING REPORT SEMI-ANNUAL EVENT SEPTEMBER 2002

BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

PREPARED FOR:

BOEING REALTY CORPORATION
5760 KILROY AIRPORT WAY, SUITE 500
LONG BEACH, CALIFORNIA 90806

NOVEMBER 18, 2002



**GROUNDWATER MONITORING
SEMI-ANNUAL EVENT – SEPTEMBER 2002**

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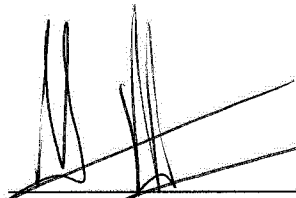
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November 18, 2002

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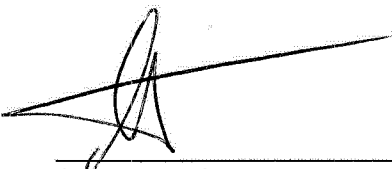

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TABLE OF CONTENTS

	Page
LIST OF TABLES	ii
LIST OF FIGURES	ii
I. INTRODUCTION	1
II. SITE BACKGROUND	1
2.01 Site Location	1
2.02 Site History	1
2.03 Regional Geology and Hydrogeology	2
2.04 Site Geology and Hydrogeology	3
A. Geology	3
B. Hydrogeology	3
III. GROUNDWATER SAMPLING PROCEDURES	4
3.01 Monitoring Plans	4
3.02 Field Procedures	5
3.03 Sample Naming	5
3.04 Proposed Work Variances	5
IV. MONITORING AND SAMPLING RESULTS	6
4.01 Groundwater Elevations	6
4.02 Groundwater Quality	6
V. QUALITY ASSURANCE/QUALITY CONTROL	9
5.01 Field Quality Control Samples	9
A. Field Duplicates	9
B. Equipment Rinsate Blanks	9
C. Field Blanks	9
D. Trip Blanks	9
E. Data Validation and Laboratory QA/QC Samples	10
VI. CONCLUSIONS	10
REFERENCES	11

TABLES**FIGURES****APPENDIX A – Field Data****APPENDIX B – Analytical Reports and Chain-of-Custody Records (STL Los Angeles)**
Electronic Format on Compact Disc**APPENDIX C – Data Validation****APPENDIX D – Limitations****LIST OF TABLES**

Table No.	Title
1	Well Information
2	Groundwater Elevations – September 2002
3	Historic Groundwater Elevations
4	Volatile Organic Compounds by EPA 8260B – September 2002
5	Summary of Historic Volatile Organic Compounds
6	Monitored Natural Attenuation Parameters – September 2002

LIST OF FIGURES

Figure No.	Title
1	Site Location Plan
2	Site Plan Showing Groundwater Monitoring Wells Sampled in September 2002
3	Generalized Geologic Cross-Section
4	Groundwater Elevation Map – September 2002
5	TCE Distribution in MBFB Groundwater – September 2002
6	1,1-DCE Distribution in MBFB Groundwater – September 2002

I. INTRODUCTION

Haley & Aldrich, Inc. (H&A) has prepared this report on behalf of Boeing Realty Corporation (BRC) in order to document the Groundwater Monitoring Semi-Annual Event (2002 Semi-Annual event) conducted at the former C-6 Facility in Los Angeles, California (Site).

The 2002 Semi-Annual event was conducted at the Site from September 13 to 19, 2002. The program included the following activities:

- Groundwater elevation measurements in 29 wells;
- Groundwater samples from 15 wells and subsequent analysis for volatile organic compounds (VOCs) by US Environmental Protection Agency (EPA) Method 8260B; and
- Monitored natural attenuation (MNA) parameter measurements in three wells for dissolved oxygen (DO), oxidation-reduction potential (ORP), and pH.

This report provides documentation and discussion of the 2002 Semi-Annual event.

II. SITE BACKGROUND

2.01 Site Location

The Site is located at 19503 South Normandie Avenue, in Los Angeles, California. The Site occupies approximately 170 acres in an area located between the cities of Torrance to the west and Carson to the east.

The Site is bound on the north by 190th Street; on the east by Normandie Avenue; on the west by the former Industrial Light Metals (ILM) facility; and on the south by the former Montrose Chemicals facility and a residential area. A Site location plan is included as Figure 1 and a Site plan as Figure 2.

2.02 Site History

The Site was reportedly used for the manufacturing of aircraft and aircraft parts for 40 years, between 1952 and 1992. Prior to that time, industrial uses of the Site included aluminum and steel production. Before 1940, the Site was reportedly farmland. A limited amount of assembly and activities related to warehousing continued through mid-2000. The Site is currently demolished, with various stages of redevelopment activities underway.

Groundwater investigation activities began in 1987 at the Site. Forty groundwater monitoring wells have been installed at the Site. Fourteen of these 40 wells have since been removed as a result of redevelopment activities. Prefixes of Site groundwater monitoring wells include BL, DAC, WCC, TMW and XMW. Table 1 is a compilation of the groundwater monitoring well details.

2.03 Regional Geology and Hydrogeology

A description of the geology and hydrogeology of the region surrounding the Site is drawn from reports published by the U.S. Geological Survey (USGS) (Poland and others, 1959) and the California Department of Water Resources (DWR, 1961). Reference is also made to previous Site reports prepared by Kennedy/Jenks Consultants (Kennedy/Jenks Consultants, 2000).

The Site is located on a broad plain at an approximate elevation of 52 feet above mean sea level (MSL). The DWR and USGS define this area as the Torrance Plain, a Pleistocene-age marine surface and subdivision of the West Coast Basin/Coastal Plain of Los Angeles and Orange Counties. The ground surface is generally flat, with an eastward gradient of approximately 20 feet per mile (less than one-half percent). Surface drainage is generally toward the Dominguez Channel, approximately one mile to the east. The Dominguez Channel flows southeastward toward the Los Angeles and Long Beach Harbors, in San Pedro Bay.

The West Coast Basin includes a thick sequence (up to 13,000 feet) of marine and continental sediments (Miocene to Recent), deposited in a broad synclinal depression over a basement complex of igneous and metamorphic rocks. The uppermost sequence of deposits of interest within the West Coast Basin is as follows:

Youngest	Active Dune Sand
↑	Alluvium
	Older Dune Sand
↓	Lakewood Formation (upper Pleistocene)
Oldest	San Pedro Formation (lower Pleistocene)

The dune sands and alluvium are not present at the Site. The Lakewood Formation is mapped at the surface in the Site vicinity.

The Lakewood Formation (DWR, 1961), includes the upper Pleistocene deposits located in the sediments of the Los Angeles Coastal Plain area. These deposits are of marine and continental origin, and represent stream transport and sedimentation along the Pleistocene marine plain. In the Site area, the Lakewood Formation also may include the Semi-perched aquifer, the Bellflower Aquitard, and the Gage Aquifer. The Semi-perched aquifer includes deposits described as Terrace Cover (Poland and others, 1959). Based on correlations between Site stratigraphic and adjacent sites data, it appears that the Semi-perched aquifer is absent from the Site. The Bellflower Aquitard is a heterogeneous mixture of continental, marine, and wind-blown sediments, consisting mainly of clays with sandy and gravelly lenses (DWR, 1961). The elevation of the base of the Bellflower Aquitard is at about -100 feet MSL or about 150 feet below ground surface (bgs) in the Site area. The Gage Aquifer is a water-bearing zone of fine to medium sand and gravel confined by the Bellflower Aquitard. It is reported to be approximately 40 feet thick in the Site area.

The Lakewood Formation is underlain by the Lower Pleistocene San Pedro Formation, which continues to approximately 1,000 feet bgs in the Site area. The major water-bearing zones within the San Pedro Formation are the Lynwood Aquifer and the Silverado Aquifer. These are reported to occur at approximately 300 and 500 feet bgs, respectively, in the Site area (DWR, 1961). The Silverado Aquifer is an important groundwater source in the Coastal Plain, and considered a source of drinking water (DWR, 1961).

2.04 Site Geology and Hydrogeology

A. Geology

Groundwater monitoring wells and soil borings drilled at the Site encountered the Lakewood Formation. Monitoring well borings were drilled from the ground surface to depths ranging from 79 to 140 feet bgs. The top 20 to 50 feet below the Site consisted of mainly fine-grained soils (predominantly silts and clays) that become thicker to the east. A sandy zone that dips downward to the east, underlies the fine-grained soils. The sandy zone is generally 80 to 100 feet thick and contains interbedded layers of fine-grained sediment that also dip down to the east.

B. Hydrogeology

Groundwater samples from monitoring wells at the Site have been collected and analyzed on a regular basis since 1987. The uppermost groundwater at the Site appears to be under water table conditions at elevations of approximately -12 to -16 feet MSL (64 to 68 feet bgs). Regionally, this upper most groundwater appears to be within relatively permeable sediments of the Bellflower Aquitard. Most of the monitoring wells completed in the Bellflower Aquitard are at or near the water table with screened depths ranging from approximately 58 to 91 feet bgs. Two deeper wells, WCC-1D and WCC-3D, were completed in a deeper zone with screened depths from approximately 120 to 140 feet bgs. Both of these wells have since been abandoned (Table 1).

The following primary hydrogeologic units are recognized in the general vicinity of the Site:

FORMATION	HYDROSTRATIGRAPHIC UNIT	
<i>Lakewood Formation</i> (Upper Pleistocene)	Bellflower Aquitard	Upper Bellflower Aquitard (UBF)
		Middle Bellflower Aquitard (MBF, MBFM, MBFC, MBFB/C)
		Lower Bellflower Aquitard (LBF)
	Gage Aquifer (GAGE)	
<i>San Pedro</i> (Lower Pleistocene)	Gage Lynwood Aquifer (GLA)	
	Lynwood Aquifer (LYNWOOD)	
	Unnamed Aquifer	
	Silverado Aquifer	

The relatively fine-grained Upper Bellflower Aquitard (UBF) is continuous across the area, but thins to the northwest. The UBF is comprised of laminated to massive yellowish brown muds, with local sands and fossiliferous zones. The UBF is found at the surface beneath the Site and is approximately 70 feet thick. A generalized geologic cross-section is included as Figure 3.

The Middle Bellflower Aquitard (MBF) is a massive, light yellowish brown, fine to medium sand, with local muddy zones. An extensive mud layer referred to as the Middle Bellflower Mud (MBFM) locally interrupts this sand. Where divided, the sand subunits are referred to as the B-Sand (MBFB) and C-Sand (MBFC). The top of the MBFB is found at an approximate elevation of -12 to -20 feet MSL (64 to 72 feet bgs) at the Site, and is generally from 25 feet to 40 feet thick. The MBFM is discontinuous across the area, and is comprised of laminated silts, layered silts, and very fine sands. Deeper borings at the former ILM facility and the Site do not always encounter the MBFM. The top of the MBFC is found at an approximate elevation of -45 to -55 feet MSL (97 to 107 feet bgs) at the Site (Figure 3).

The fine-grained Lower Bellflower Aquitard (LBF) is reported continuous across the area. The top of the LBF occurs at an approximate elevation of -62 to -98 feet MSL (114 to 150 feet bgs), and ranges in thickness from 10 to 25 feet thick (Figure 3). The LBF separates the Bellflower sands from the underlying Gage Aquifer. The Gage Aquifer in the Site vicinity is predominantly sand, and ranges in thickness from 40 to 78 feet. No monitoring wells have been drilled into the Gage Aquifer at the Site (Kennedy/Jenks Consultants, 2000).

III. GROUNDWATER SAMPLING PROCEDURES

3.01 Monitoring Plans

The 2002 Semi-Annual event at the Site was conducted from September 13 to 19, 2002, by Tait Environmental Management, Inc. (TEM) field personnel. Work was conducted in accordance with the following documents:

- *Groundwater Monitoring Workplan 2002* by Haley & Aldrich, Inc., dated December 20, 2001, approved by the Los Angeles Regional Water Quality Control Board (LARWQCB) on January 25, 2002.
- *Standard Operating Procedure, Groundwater Gauging and Sampling*, prepared by Tait Environmental Management, dated September 9, 2002.

Monitored natural attenuation sampling was conducted according to:

- *Standard Operating Procedures for Measuring Natural attenuation Parameters at Boeing Realty Corporation Former C-6 Facility, Revision 1.0*, prepared by Haley & Aldrich, Inc. and England Geosystem Inc., dated January 9, 2001.

The activities performed during the Semi-Annual Groundwater Monitoring and Sampling event are as follows.

- **Groundwater Elevation Measurement**

- Water levels were measured in 29 Site groundwater wells on September 13, 2002 (Table 2).
- A groundwater elevation contour map was generated based on these measurements.

- **Well Purging, Sampling and Analysis**

- At least 3 wetted casing volumes of water were purged with a submersible pump from each well.
- Purge water was monitored for stability of pH, temperature, and specific conductivity.
- Groundwater samples were collected from 15 wells with a submersible pump and analyzed for VOCs by EPA Method 8260B.
- QA/QC samples were also collected and analyzed for VOCs by EPA Method 8260B.

- **Monitored Natural Attenuation (MNA) Parameters**

- MNA parameters (DO, ORP, and pH) were measured in the field.

3.02 Field Procedures

Field procedures for this sampling event are outlined in the documents listed previously in Section 3.01.

3.03 Sample Naming

Groundwater samples were labeled in the following format in accordance with the Boeing Data Management Plan (DMP) prepared by CH2MHill and dated January 2002 (CH2Mhill, 2002):

For example: TMW_11_WG091702_0001

Where:

TMW_11 indicates the groundwater monitoring well name
WG = Groundwater sample
091702 = date the sample was collected (mmddyy)
0001 = the number of samples taken from the well

3.04 Proposed Work Variances

Groundwater monitoring well TMW-13 was scheduled for sampling during the Semi-Annual Monitoring Event; however, during sampling pump installation, the pump became lodged in the casing above the water table and could not be recovered during repeated attempts by a drilling contractor. TMW-13 is scheduled for abandonment due to Site redevelopment in November 2002.

IV. MONITORING AND SAMPLING RESULTS

4.01 Groundwater Elevations

Field sheets for the data collected by TEM are included in Appendix A. A summary of the groundwater elevations for the 2002 Semi-Annual event is presented in Table 2.

During the 2002 Semi-Annual event, groundwater elevations at the Site ranged from -12.71 to -15.14 feet MSL, or approximately 65 feet bgs. The groundwater elevation measurements are included in Table 2. Due to Site redevelopment activities, the wells were re-surveyed by a registered land surveyor prior to this sampling event; therefore, top of casing elevations have changed from previous values (increased up to 2.6 feet). Overall, groundwater elevations have decreased up to approximately 1.1 feet compared to the values measured in March 2002, except wells TMW-4 and TMW-8 which increased approximately 1.7 and 2.6 feet, respectively. A comparison of groundwater elevation data over the past two years in TMW-4 and TMW-8 suggests that the groundwater elevation measurements from the March 2002 sampling event in wells TMW-4 and TMW-8 were incorrect. These errors were likely due to casing modifications as a result of Site redevelopment activities. Therefore, the groundwater elevations in TMW-4 and TMW-8 may not have actually increased since March 2002. Historic groundwater levels are presented in Table 3.

Figure 4 is a groundwater elevation contour map of the MBFB (B-Sand) water-bearing zone generated using data collected during the 2002 Semi-Annual event. The average horizontal hydraulic gradient in the MBFB was calculated to range from approximately 0.0010 to 0.0014 ft/ft to the south in September 2002, as compared to approximately 0.0015 ft/ft to the south calculated for March 2002 (excluding wells TMW-4 and TMW-8). Based on the groundwater elevation contours shown on Figure 4, the hydraulic gradient varies across the Site along the various flow vectors. The groundwater in the MBFB appears to generally flow to the south.

4.02 Groundwater Quality

VOC Results

Results of VOC analysis by EPA Method 8260B for the 2002 Semi-Annual event, conducted in September 2002, are summarized in Table 4 and on Figures 5 and 6. Based on visual observations during well sampling, TEM recorded no indications of dense non-aqueous phase liquid (DNAPL) in any of the sampled wells. Based on a review of previous monitoring reports, general plume geometries for trichloroethene (TCE) and 1,1-dichloroethene (1,1-DCE) appear to be generally unchanged since 1999 (Haley & Aldrich, Inc. and England Geosystem Inc., 2001b and 2001c and Haley & Aldrich, Inc., June 2002).

Figure 5 shows the dissolved-phase TCE concentrations in the MBFB. TCE concentrations in groundwater samples are similar (increased less than 20%) compared to the March 2002 sampling event in the 15 wells sampled, with the exception of well TMW-5. TCE concentrations increased in well TMW-5 from 3,900 (March 2002) to 8,800 µg/l. Prior TCE concentrations in TMW-5 range from below laboratory detection limits to 5,000 µg/l. TMW-

5 will be destroyed in November 2002 due to Site redevelopment activities. However, this general area of the Site will continue to be monitored according to the Site-Wide Long-Range Groundwater Monitoring Plan that will be submitted to the LARWQCB in early 2003.

Noteworthy decreases (greater than 20% variation from the previous sampling event) in TCE concentrations were observed in the samples collected from TMW-2 (from 11,000 to 8,400 µg/l) and TMW-6 (from 160 to 53 µg/l). TCE concentrations in the sample from TMW-2 (located near the former Building 1/36 postulated VOC source area) have declined (approximately 24%) since the previous monitoring event.

Figure 6 shows the dissolved-phase 1,1-DCE concentrations in the MBFB. 1,1-DCE concentrations in groundwater samples have generally decreased or stayed the same in the monitored wells, with the following exceptions: TMW-1 (from 24 to 170 µg/l), TMW-2 (from 20,000 to 27,000 µg/l), TMW-5 (from 250 to 640 µg/l) and TMW-7 (from 200 to 390 µg/l). It is important to note that 1,1-DCE has not been detected at DAC-P1, TMW-10, TMW-11, TMW-14 and TMW-16.

Eight wells were reported to have detectable concentrations of tetrachloroethene (PCE) up to 13 µg/l. Five of the eight samples with detected PCE concentrations are less than 5 µg/l. Two of the eight detected PCE concentrations were at low levels that could not be quantified by the laboratory (<1 µg/l), and are noted in Table 4 with a "J" flag. The one additional sample reported to contain a detectable concentration of PCE was TMW-12 (13 µg/l).

Concentrations of 1,1,1-trichloroethane (1,1,1-TCA) were not detected in 13 of the 15 wells sampled, and were not detected in the previous sampling event. The concentration of 1,1,1-TCA in the groundwater sample from well TMW-2 increased from 650 to 1,400 µg/l. Well TMW-3 was reported to have a low concentration of 1,1,1-TCA that could not be quantified by the laboratory (8.5J µg/l.)

As in previous sampling events, some minor occurrences of VOCs other than those described above, were detected and are tabulated on Table 4. These occurrences included:

- Cis-1,2-DCE concentrations in groundwater have generally increased. Along with this increase, TCE concentrations have generally decreased, which is indicative that biotransformation of TCE is occurring at the Site. The well that best shows this relationship is TMW-2. TMW-2 was reported to have an increase in cis-1,2-DCE concentrations (increased from 7,800 to 14,000 µg/l) and a decrease in TCE concentrations (11,000 to 8,400 µg/l) in the March 2002 sampling event. Well TMW-14 was also reported to have increasing concentrations of cis-1,2-DCE and decreasing concentrations of TCE, as shown in Table 5.
- Chloroform concentrations in groundwater samples have generally remained the same (less than 20% variances) in the 15 wells sampled, except in three wells (TMW-2, TMW-6, and TMW-12). Chloroform increased in well TMW-2 from 110J to 240 µg/l; in well TMW-6 from 130 to 180 µg/l; and in

well TMW-12 from 1,200 to 1,600 µg/l. These values are within historical range of fluctuation for each well as shown on Table 5.

- Benzene concentrations in groundwater samples have generally remained the same except in well TMW-2. Well TMW-2 was reported to have a benzene concentration that could not be quantified by the laboratory (66J µg/l). Benzene was not detected in well TMW-2 in the previous sampling event (<250 µg/l).
- Methyl ethyl ketone (2-butanone) was only detected in well TMW-2 at a concentration of 140,000 µg/l. This is an increase from the previous sampling event in March 2002 (below laboratory detection limits [$<1,200$ µg/l]). MEK was previously detected in well TMW-2 in July 2001, at a concentration of 75,000 µg/l.
- Toluene concentrations in groundwater samples have generally remained the same except in well TMW-2 (increased from 1,700 µg/l to 5,200 µg/l). Low concentrations of toluene (<5 µg/l) were detected in two wells (TMW-10 and TMW-15), and one well (TMW-14) was reported to have a toluene concentration that could not be quantified by the laboratory (9.8J µg/l). Well DAC-P1 was reported to have a toluene concentration of 18,000 µg/l, which is similar to the toluene concentrations in this well over time as shown in Table 5.

Field MNA Parameters

Field monitoring of DO, ORP, and pH was conducted during the September 2002 monitoring and sampling event. A summary of the September 2002 MNA parameters is included in Table 6 and on the Field Data Sheets in Appendix A. These parameters are similar to the March 2002 annual sampling event data, and suggest that in-situ conditions have not changed. The distribution of DO and ORP suggests evidence of intrinsic biotransformation of VOCs in the potential source area near former Buildings 1, 2 and 36, as well as along the southern property boundary. It appears that DO has been depleted within the areas of TCE and 1,1-DCE-impacted groundwater. ORP is negative within the Building 1/36 area (TMW-2), indicating anaerobic reducing conditions.

V. QUALITY ASSURANCE/QUALITY CONTROL

5.01 Field Quality Control Samples

A. Field Duplicates

One duplicate groundwater sample was analyzed for VOC concentrations from well TMW-1. These results are included in Table 4. Duplicate laboratory data can be used to measure how well replicate measurements reproduce and estimate overall method precision. Relative percent difference (RPD) is a measure of precision and is calculated as follows:

$$(\text{Result 1} - \text{Result 2}) / \frac{1}{2} (\text{Result 1} + \text{Result 2}) * 100\%$$

The RPD will often vary with the concentration of analyte; RPD lessening as the concentration increases. If the variation is greater than plus or minus 15% but less than 100%, the reported concentrations are up to standard. If the variation is greater than 100%, the data is subject to further evaluation (i.e., comparison with historic data from the well). The data from TMW-1 and the TMW-1 duplicate were reported to have RPDs less than or equal to 31%, which indicates that the reported concentrations are up to standard.

B. Equipment Rinsate Blanks

One equipment rinsate blank was collected each day after cleaning the sampling equipment with deionized water. These rinsate samples were analyzed for VOCs by EPA Method 8260B. Estimated concentrations of bromodichloromethane and chloroform (0.72J and 0.54J µg/l) were detected in the equipment rinsate blank below the contracting laboratory reporting limit (1 µg/l) collected on March 16, 2002 as shown on Table 4.

C. Field Blanks

One field blank was collected each day with laboratory-supplied water to check for contamination by sampling methodology. These field blank samples were analyzed for VOCs by EPA Method 8260B. VOCs were not detected in any of the field blank samples.

D. Trip Blanks

One laboratory-prepared trip blank was shipped to the laboratory each day to check for cross-contamination. The samples were analyzed for VOCs by EPA Method 8260B. Estimated concentrations of acetone (6.0J and 8.5J µg/l) were detected below the contracting laboratory reporting limit (10 µg/l) in two of the trip blanks, as shown in Table 4.

E. Data Validation and Laboratory QA/QC Samples

Final laboratory-certified reports and laboratory quality control procedures are included on the compact disc (CD) as Appendix B.

Tier II data validation was performed on 10% of the samples and Tier III data validation was performed on 5% of the samples. Based on the data validation results, the data collected during this event is adequate for continued characterization and monitoring of VOCs in groundwater beneath the Site. Data validation results are provided in Appendix C.

Appropriate data qualifiers, as determined by Laboratory Data Consultants, Inc. (LDC) (data validation subcontractor), have been included where appropriate.

VI. CONCLUSIONS

Groundwater levels, on average, have decreased beneath the BRC Former C-6 Facility since the last sampling event up to approximately 1.1 feet. The average hydraulic gradient beneath the Site remains low, and apparent groundwater flow direction appears similar to those of previous monitoring events.

In general, concentrations of dissolved chlorinated VOCs have remained approximately the same since the previous monitoring event, with the primary exceptions of wells TMW-2 and TMW-5. The data from TMW-2 will be reviewed again in March 2003 to evaluate for the presence of developing trends. TMW-5 will be destroyed in November 2002; however, this general area of the Site will continue to be monitored in the future using new wells according to the Site-Wide Long-Range Groundwater Monitoring Plan. The plume geometry remains relatively constant based on the existing well network.

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